

Appendix M

Environmental Noise Analysis

**LONE STAR NORTHWEST
MAURY ISLAND MINING EXPANSION**

**Environmental Noise Analysis for
Expanded Environmental Checklist**

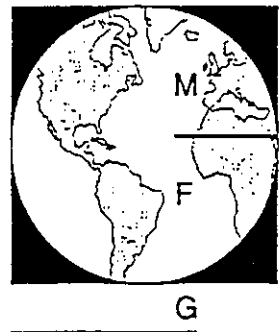
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MFG PROJECT # 9301

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INTRODUCTION

This report describes the existing noise environment in the project area and sound levels that can be expected to occur with the Proposed Expansion of Lone Star Northwest's Maury Island Pit. Measures that would or could be taken to reduce noise impacts are also identified.

AFFECTED ENVIRONMENT

Introduction to Noise Descriptors

The human ear responds to a very wide range of sound intensities. The decibel (dB) scale used to describe sound is a logarithmic rating system that accounts for the large differences in audible sound intensities. Using this scale, humans perceive a doubling of *loudness* as an increase of 10 dB. Therefore, a 70 dB noise source sounds twice as loud as a 60 dB source. Under ideal conditions, people generally cannot detect differences of 1 dB while differences of 2 or 3 dBs can be detected. In the outside environment such as near roads, a change of 2 or 3 dBs would not be noticeable to most people, while a 5 dB change would be expected to be perceived under normal listening conditions.

Because of the logarithmic scale used to describe noise, a doubling of the noise source *strength* (e.g., twice as much equipment) produces a 3 dB increase in average equipment noise. A doubling of a noise source *strength* would not result in a perception of a doubling of *loudness* which would generally require a 10 dB increase in noise.

When addressing the effects of noise on people, it is necessary to consider the frequency response of the human ear. Instruments that measure sounds are therefore designed to respond to, or ignore, certain frequencies. The frequency-weighting most often used to evaluate environmental noise is A-weighting, and measurements from instruments using this system are reported in "A-weighted decibels" or dBA. All sound levels in this evaluation are reported in A-weighted decibels.

For a given noise source, factors affecting the noise impact include distance from a source, frequency of the sound, the absorbcency of the ground, obstructions, and duration. Average sound levels due to point sources (i.e., most mining equipment at a distance) decrease with distance from the source at a rate of 6 dB per doubling of the distance. Conversely, moving half the distance closer to a point source increases the sound level by 6 dB. The degree of impact also depends on who is listening and on existing sound levels. For example, if background noise levels are high, introducing a new noise source would tend to have less impact than in an environment where background noise levels are low.

Typical sound levels of familiar noise sources and activities are presented in Table 1.

Table 1. Sound Levels Produced by Common Noise Sources

Thresholds/ Noise Sources	Sound Level (dBA)	Subjective Evaluations	Possible Effects on Humans
Human Threshold of Pain Carrier jet takeoff (50 ft)	140	Deafening	Continuous exposure can cause hearing loss
Siren (100 ft) Loud rock band	130		
Jet takeoff (200 ft) Auto horn (3 ft)	120		
Chain saw Noisy snowmobile	110		
Lawn mower (3 ft) Noisy motorcycle (50 ft)	100	Very	
Heavy truck (50 ft)	90	Loud	
Pneumatic drill (50 ft) Busy urban street, daytime	80	Loud	Speech Interference
Normal automobile at 50 mph Vacuum cleaner (3 ft)	70		
Large air conditioning unit (20 ft) Conversation (3 ft)	60	Moderate	Sleep Interference
Quiet residential area Light auto traffic (100 ft)	50		
Library Quiet home	40	Faint	
Soft whisper (15 ft)	30		
Slight Rustling of Leaves	20	Very Faint	
Broadcasting Studio	10		
Threshold of Human Hearing	0		
Note that both the subjective evaluations and the physiological responses are continuums without true threshold boundaries. Consequently, there are overlaps among categories of response that depend on the sensitivity of the noise receivers.			

Regulatory Overview - King County Noise Code

Lone Star Northwest's Maury Island sand and gravel pit is located in unincorporated King County. The County code establishes limits on the levels and durations of noise crossing property boundaries. Allowable maximum sound levels depend on the district (land use zone) of the source of the noise and the district (land use zone) of the receiving property when both are located in King County (see Table 2).

Table 2. King County Environmental Noise Limits (dBA)

DISTRICT of NOISE SOURCE	DISTRICT OF RECEIVING PROPERTY			
	Rural Day/Night	Residential Day/Night	Commercial	Industrial
Rural	49/39	52/42	55	57
Residential	52/42	55/45	57	60
Commercial	55/45	57/47	60	65
Industrial	57/47	60/50	65	70

King County's noise criteria can be exceeded for certain periods of time:

- 5 dBA for no more than 15 minutes in any hour; or
- 10 dBA for no more than 5 minutes of any hour; or
- 15 dBA for no more than 1.5 minutes of any hour.

Sometimes these exceptions are described in terms of the percentage of time a certain level is exceeded. For example, L₂₅ represents a sound level that is exceeded 25 percent of the time, or 15 minutes in an hour. Similarly, L_{8.3} and L_{2.5} are the sound levels that are exceeded 5 and 1.5 minutes in an hour, respectively. At no time can the allowable sound level be exceeded by more than 15 dBA.

King County's noise code identifies a number of noise sources or activities that are exempt from the maximum permissible noise levels described previously:

- sounds created by traffic on public roads;
- sounds created by warning devices (such as back-up alarms on vehicles) when not operated continuously for more than 30 minutes per incident;
- Sounds from blasting and from construction equipment are exempt from the ordinance during the day (7 a.m. to 10 p.m. weekdays, 9 a.m. to 10 p.m. weekends) in rural and residential districts.

Maximum permissible sound levels from **individual** motor vehicles are regulated by Chapter 12.90.010 of the King County Code.

Existing Land Uses/Zoning

King County is the local authority responsible for planning and zoning in the project area. The Maury Island site is labeled a Mineral Resource in King County's Comprehensive Plan and is zoned for mining. Mining is also the existing use on the property. Consequently, the site is an industrial noise source according to the King County Noise Code.

The Maury Island site is bordered by Puget Sound to the south, forest owned by the State of Washington in the northwest corner, SW 260th Street and more forestry to the north, residences to the west, and the communities of Gold Beach and Sandy Shores to the northeast and southwest, respectively. The surrounding properties are zoned as either RA-2.5 (rural residential use, 1 dwelling unit per 2.5 acres) or forestry. For the purpose of this analysis, potential noise impacts are identified at sensitive receptors (i.e., residences) in the project vicinity zoned for rural residential use. Therefore, the applicable King County Limits (shown in Table 2) would be for an industrial source affecting rural receivers.

Existing Conditions

Concerns have been raised about the noise impacts to residences in the vicinity of the Maury Island site; especially those residences with an unobstructed view of on-site or barge-loading activities. MFG measured existing sound levels at two locations in the project area (See Figure 1) that represent potentially-impacted residences. These include one residence near the shoreline in Gold Beach, and a residence on a hillside in Sandy Shores overlooking Puget Sound. The Gold Beach measurement is representative of those residences in Gold Beach and Sandy Shores located on or near the shoreline. The Sandy Shores measurement represents residences in the vicinity of the site located higher on the hill, away from the shoreline. Measurements were taken for most of a day/night period in one-hour intervals with Larson Davis 820 (Type I) sound level meters. The results of these measurements are summarized in Table 3. Detailed tabulations of the measurements are provided in Attachment A.

Table 3. Existing Sound Levels (dBA)

SLM	Hours	Leq	L02	L08	L25	L90
Gold Beach	7 a.m. - 10 p.m.	43-51	51-57	47-53	43-51	35-47
	10 p.m. - 7 a.m.	38-45	46-53	40-49	36-46	32-42
Sandy Shores	7 a.m. - 10 p.m.	43-53	51-61	47-54	42-51	34-46
	10 p.m. - 7 a.m.	37-46	43-52	39-49	34-47	32-41

SLM location 1 - The sound level meter was placed on the back deck of 25914 Gold Beach Drive and overlooked Puget Sound. This location has a clear view to the barge loading dock. Noise sources audible while present at this location were water lapping on the shore, airplanes, and nearby residential activities.

SLM location 2 - The sound level meter was placed in the backyard of 8909 SW 274th Street. This location was on a hill overlooking Puget Sound and the existing dock. Noise sources audible while present at this location were wind in the trees, distance airplanes, the HVAC system of the residence, and activity of the resident outside.

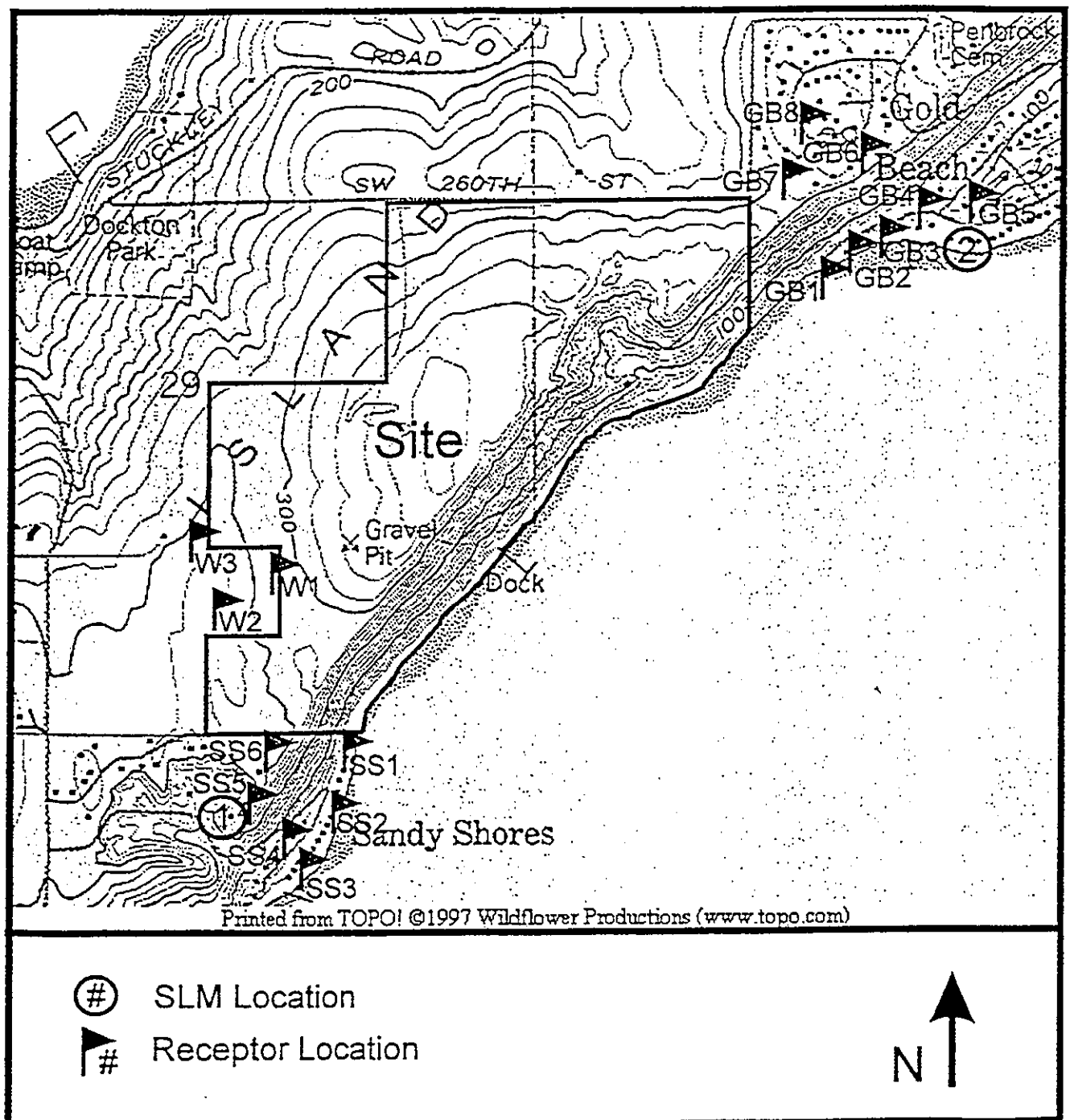


Figure 1. Sound Level Measurement and Receptor Locations

ENVIRONMENTAL NOISE IMPACTS

Construction Noise

There would be an increase in sound levels on the site beginning with the reconstruction of the processing plant and conveyors and the maintenance of the loading dock. On-site construction noise generation would depend on the type of equipment being used and the amount of time it is in use. Table 4 identifies noise levels associated with typical construction equipment. The closest the initial construction activity would get to nearby residences is approximately 1000 feet with most distances being 1500 feet or greater.

During the reconstruction/maintenance of the on-site equipment and loading dock, there may be a slight increase in noise along roads leading to the site due to increased truck traffic related to the transportation of construction materials. During the life of the pit, there would be progressive clearing of trees, dismantling and reconstruction of the sand and gravel conveyors, and the reclamation of mined areas.

The sound levels of construction equipment at 1000 feet shown in Table 4 account only for distance attenuation. Topography on the Maury Island site would likely make construction sound levels at 1000 feet much lower than those shown, and the noise due to most on-site construction activities would likely be negligible. Also, all construction would occur only during daytime hours and would be exempt from the County noise ordinance.

Table 4. Typical Construction Equipment Noise

Construction Activity	Types of Equipment	Range Of Noise Levels (dBA)	
		At 50 ft	At 1000'
Clearing	Bulldozer	77-96	51-70
	Dump Truck	82-94	56-68
Grading	Scraper	80-93	54-67
	Bulldozer	77-96	51-70
Paving	Paver	86-88	60-62
	Dump Truck	82-94	56-68
Stationary Equipment	Generators	71-82	45-56
	Compressors	74-87	48-61

The range of sound levels presented stem from the variety of types of equipment that may be used for particular tasks as well as the different sound levels that may be produced by different operational modes of the same equipment. For example, some equipment will make more noise when handling heavy loads than when simply idling.

Source: U.S. Environmental Protection Agency, 1971. Sound levels of pile driving measured by MFG in 1994

Operational Noise

The proposed expansion of Lone Star Northwest's Maury Island facility would generate noise from on-site mining, conveying, processing and shipping by either barge or truck. These noise sources are discussed separately in the following two sections.

Site-generated Noise

On-site noise sources associated with the operation of the proposed Maury Island facility include:

- bulldozers and/or loaders used to mine the material;
- a loader to load the material into trucks or into a hopper that feeds the raw material conveyor;
- a conveyor carrying raw material from the mining area to the processing (crushing/screening) plant;
- a portable crushing and screening plant (processing plant) used to sort, crush, and stockpile sand and gravel, and conveyors used to distribute the finished product;
- a conveyor carrying product from the processing plant to the loading dock on Puget Sound;
- the loading of barges, including noise from the conveyors and the tugs;
- trucks delivering additives, fuel and other materials and trucks removing product;

The following on-site sources of noise were judged to have the potential to create off-site noise impacts and were included in the noise modeling:

- 1) the processing plant;
- 2) a front-end loader operating near the processing plant;
- 3) dozers and/or loaders excavating in the pit; and
- 4) the barge loading activities;

Although there would be conveyors from the mining area to the processing plant and from the processing area to the barge loading facility, the conveyors are not expected to be significant noise sources compared with those identified above. Several measurements of sound levels associated with conveyors and multiple transfer points revealed sound levels of about 65 dBA at 100 feet. Conveyors are relatively low sound level sources in terms of both noise output and height and were, therefore, not included in the noise modeling.

Truck traffic is also not anticipated to be a significant noise source. Truck traffic to and from the site would not increase significantly over the currently volumes; the vast majority of material will be barged off the site. Therefore, trucks were not included in the noise modeling.

In order to accurately characterize the sound of the equipment most likely to cause noise impacts, MFG measured sound levels of representative equipment. MFG used a Larson Davis 2900 to measure the L₂₅ of each piece of equipment in 1/3 octave band sound pressure levels.

The L25s were used instead of the average hourly levels (Leqs) in order to best represent the King County noise standards. The broad band results of these measurements are displayed in Table 5.

Table 5. Summary of Source Noise Levels

Source	L25 (in dBA at 100 feet)
1) Processing plant	83
2) Barge Loading	64
3) Bulldozer	83
4) Front-end loader	83
1) MFG measured the crusher plant operating at Lonestar's Mats Mats pit. 2) MFG measured the sound levels of a barge being loaded at Lonestar's Dupont facility. The material being loaded, rock mixed with sand, is anticipated to be similar to the material extracted from the Maury Island pit. The sound level of the loading represented above does not include the warning alarm sounded at the onset of loading or the squeaks of the conveyor. Both of these sounds are louder than the barge loading but can be effectively mitigated through the use of strobe lights for the alarm and adequate maintenance for the squeaky equipment. 3) MFG measured a CAT D10 bulldozer operating at Lonestar's Dupont site over several cycles of the dozer moving material. 4) MFG measured a CAT 992 front-end loader at Lonestar's Dupont site over several cycles of the loader excavating material and dumping it into a hopper.	

ENM

Noise generated by on-site noise sources were evaluated using the Environmental Noise Model (RTA, 1989). ENM is a state-of-the-art computer program designed specifically to evaluate noise propagation in the environment. The model calculates sound levels after considering the noise reductions or enhancements caused by distance, topography, ground surfaces (including water), wind, and atmospheric stability and absorption.

ENM evaluates noise impacts based on the sound power levels of the noise sources. MFG estimated sound power levels of equipment proposed for the Maury Island site based on measurements of equipment at Lone Star's Dupont and Mats Mats facilities.

After the noise sources were characterized, 3-dimensional maps for the site vicinity and for each phase (1-6) of the Maury Island site were created to enable the ENM model to evaluate effects of distance and topography on noise attenuation. Sound power levels based on the measurements of the sources were assigned to the appropriate locations on the site. ENM was then used to construct topographic cross sections and to evaluate noise impacts at noise "receptors" in the project area.

Because sound energy spreads as it radiates from a source, its apparent loudness also decreases further from the source. For a single (point) source, the sound level decreases at a rate of 6 dBA per doubling of the distance. For example, a noise level from a point source of 60 dBA at 100 feet from the source would dissipate to a level of 54 dBA at 200 feet from the source. At a distance, the mining and barge loading equipment would behave as individual point sources of noise. Sound loss due to divergence of sound energy is the same for all frequencies, and is independent of any weighting scale used. In the absence of hills or berms,

distance is the primary mechanism for decreasing the noise from the site at distant receptors.

Some of the energy in a sound wave is absorbed by the atmosphere. The amount of absorption depends on the frequency of the sound and the temperature and relative humidity of the atmosphere. This absorption is normally ignored for short distances, but the effect becomes significant as the distance between the source and receiver increases. Because of the more effective absorption of higher frequencies, atmospheric absorption would also tend to lower the pitch of noise generated at the site. Thus the "droning" sound of heavy equipment is more audible at a distance than higher-pitched squeaks.

The surfaces over which sound waves travel affect the amount of sound at a distant receptor in a complex manner. In short, a soft surface would be expected to absorb sound energy. Hard surfaces such as asphalt and water can reflect energy and increase the sound level at distant receptors. In addition, the surface can produce a reflected wave that interferes with the direct sound wave and can increase or reduce the sound level (depending on frequency). These interactions are commonly referred to as "ground effects."

If a wall or hillside obstructs the line-of-sight between a noise source and receiver, the sound waves must bend (or refract) around the obstruction in order to reach the receiver. This barrier effect would substantially reduce the noise impacts associated with the dozer and front-end loader. Topographic interference also would reduce noise impacts from the processing facilities. Where they exist, topographic barriers are often as important as distance attenuation in reducing noise impacts.

Trees are generally considered to be poor sound barriers. At frequencies below 1000 Hz, the attenuation due to trees is due more to the loosening of the soil by their roots (enhancing the ground effect) than to any effectiveness as a barrier. To obtain appreciable attenuation, dense vegetation and significant depths of vegetation are required. Except to the extent that vegetation influences ground effects, noise attenuation by vegetation was ignored in this study.

Sound propagation through the atmosphere is affected by wind and temperature change with height. During a temperature inversion, temperatures at the surface are colder than the temperatures aloft, and the atmosphere is said to be stable. This causes sound waves radiating upward to bend back toward the ground, which reduces the effectiveness of distance attenuation. Sound traveling downwind also bends downward.

Sound refracts upward when the sound is traveling upwind, or when the atmosphere is unstable. An unstable atmosphere is common on sunny days, when the ground and lower air masses are warmer than the air aloft. The bending of sound waves upward produces a "shadow zone" near the ground, where sound levels are reduced by as much as 20 dB.

The ENM model allows the user to calculate sound levels for any reasonable meteorological condition. For this noise analysis, MFG evaluated meteorological conditions consisting of a neutral atmosphere (0 °C/100 meters) with and without a 2 meter/second (4.5 mph) wind blowing from the source to the receiver. A 2 meter/second wind was evaluated because it could noticeably increase the sound levels of distant noise sources but would not significantly affect the background sound level. Higher wind speeds could also increase the sound levels of distant sources but would also increase the background sound levels. The higher background levels would serve to mask the sounds from the Maury Island site.

All the equipment at the Maury Island site was assumed to be operating at full capacity for the model runs.

Results

The results of the noise modeling with no wind and with a 2 meter/second wind are presented in Tables 6 and 7, respectively. Modeling was completed for each of the six phases of the pit with each phase as follows: phase 1 excavates the floor of the existing pit, phase 2 expands the pit floor by excavating to the northeast, phases 3 and 4 excavate to the property boundaries on the west side of the pit, and phases 5 and 6 excavate to the property boundaries on the east and northeast sides.

Lone Star has identified specific hours of operation for various components of the proposed actions. Only barge loading (with a front-end loader working to load the hopper to the conveyor) could occur 24 hours a day. Hours of operation for mining, processing and trucking would vary on a project-by-project basis, but would not occur outside of 6 a.m. to 10 p.m. Monday through Friday and 9 a.m. to 6 p.m. on Saturdays.

Maximum daytime activity in any one hour (designated as "Day" in Tables 6 and 7) includes mining, processing, and barging activities. These activities could consist of three bulldozers (or loaders) excavating in the pit, the operation of the processing plant, one loader working near the processing plant feeding the conveyors or filling trucks, and a barge being loaded. Since these activities would generally occur during daytime hours, they would need to meet King County's allowable daytime noise level of 57 dBA. However, if these activities occurred prior to 7 a.m. on a weekday, King County's allowable nighttime noise level of 47 dBA would need to be met.

Nighttime activity for this analysis was assumed to consist of the loading of the barge using the conveyor system and one loader located near the processing plant feeding the conveyor to the barge. These nighttime barge-loading activities would need to meet King County's allowable nighttime noise level of 47 dBA.

Table 6. Operational Noise Levels, Calm Conditions

Receptor		Measured Existing Sound Levels (L25s)	Calculated Sound Levels (dBA)						KC Allowable Level
			Phase 1	Phase 2	Phase 3	Phase 4	Phase 5	Phase 6	
Gold Beach									
GB1	Day	43-51	36	33	33	35	33	46	57
	Night	36-46	32	32	32	32	32	32	47
GB2	Day	43-51	37	32	32	36	33	46	57
	Night	36-46	32	32	32	32	32	32	47
GB3	Day	43-51	38	32	32	36	33	45	57
	Night	36-46	31	31	31	31	31	31	47
GB4	Day	43-51	35	27	27	34	29	43	57
	Night	36-46	24	24	24	24	26	26	47
GB5	Day	43-51	37	30	30	37	33	44	57
	Night	36-46	29	29	29	29	30	30	47
GB6	Day	42-51	33	38	30	31	39	41	57
	Night	34-47	26	27	27	27	31	31	47
GB7	Day	42-51	32	41	31	32	44	45	57
	Night	34-47	19	24	24	24	33	33	47
GB8	Day	42-51	32	38	31	31	40	41	57
	Night	34-47	17	21	21	21	30	30	47
Residences West of Site									
W1	Day	42-51	47	43	45	50	41	41	57
	Night	34-47	32	36	36	36	36	36	47
W2	Day	42-51	49	45	47	45	38	41	57
	Night	34-47	32	31	31	31	31	31	47
W3	Day	42-51	44	39	48	40	37	37	57
	Night	34-47	28	32	32	32	32	32	47

Table 6. Operational Noise Levels, Calm Conditions (continued)

Receptor		Measured Existing Sound Levels (L25s)	Calculated Sound Levels (dBA)						KC Allowable Level
			Phase 1	Phase 2	Phase 3	Phase 4	Phase 5	Phase 6	
Sandy Shores									
SS1	Day	43-51	42	40	39	42	39	42	57
	Night	36-46	37	38	38	38	38	38	47
SS2	Day	43-51	42	42	37	42	38	41	57
	Night	36-46	35	36	36	36	36	36	47
SS3	Day	43-51	42	41	36	37	38	40	57
	Night	36-46	34	35	35	35	35	35	47
SS4	Day	43-51	39	39	35	36	36	40	57
	Night	36-46	33	34	34	34	34	34	47
SS5	Day	42-51	45	40	38	44	41	41	57
	Night	34-47	31	33	33	33	35	35	47
SS6	Day	42-51	46	43	43	52	42	42	57
	Night	34-47	36	37	37	37	37	37	47

As can be seen in the above table, noise levels under calm conditions with maximum production meet King County's allowable daytime noise levels and are often well below the measured existing levels. Similarly, noise from nighttime barge loading activities in calm conditions would meet King County's allowable nighttime limits and would often fall below the measured existing levels.

Table 7. Operational Noise Levels, With 2 m/s Wind

Receptor		Measured Existing Sound Levels (L25s)	Calculated Sound Levels (dBA)						KC Allowable Level
			Phase 1	Phase 2	Phase 3	Phase 4	Phase 5	Phase 6	
Gold Beach									
GB1	Day	43-51	46	39	39	47	42	50	57
	Night	36-46	38	38	38	38	39	39	47
GB2	Day	43-51	46	39	39	47	44	50	57
	Night	36-46	37	38	38	38	39	39	47
GB3	Day	43-51	46	39	39	47	47	52	57
	Night	36-46	37	38	38	38	41	41	47
GB4	Day	43-51	44	42	43	46	49	52	57
	Night	36-46	34	36	36	36	40	40	47
GB5	Day	43-51	45	50	50	51	50	53	57
	Night	36-46	36	42	42	42	45	45	47
GB6	Day	42-51	47	49	47	47	54	53	57
	Night	34-47	38	40	40	40	47	47	47
GB7	Day	42-51	46	50	47	47	56	55	57
	Night	34-47	34	37	37	37	48	48	47
GB8	Day	42-51	46	49	46	47	54	54	57
	Night	34-47	33	36	36	36	46	46	47
Residences on Hill West of Site									
W1	Day	42-51	56	48	49	50	46	46	57
	Night	34-47	37	40	40	40	40	40	47
W2	Day	42-51	56	54	53	48	48	49	57
	Night	34-47	41	39	39	39	38	38	47
W3	Day	42-51	54	47	52	45	43	44	57
	Night	34-47	33	38	38	38	37	37	47

Table 7. Operational Noise Levels, With 2 m/s Wind (continued)

Receptor		Measured Existing Sound Levels (L25s)	Calculated Sound Levels (dBA)						KC Allowable Level
			Phase 1	Phase 2	Phase 3	Phase 4	Phase 5	Phase 6	
Sandy Shores									
SS1	Day	43-51	48	51	44	46	48	50	57
	Night	36-46	43	43	43	43	43	43	47
SS2	Day	43-51	49	51	46	49	48	49	57
	Night	36-46	41	42	42	42	42	42	47
SS3	Day	43-51	50	50	45	44	47	48	57
	Night	36-46	40	41	41	41	41	41	47
SS4	Day	43-51	48	50	42	43	47	48	57
	Night	36-46	40	40	40	40	40	40	47
SS5	Day	42-51	53	52	50	51	50	50	57
	Night	34-47	44	44	44	44	44	44	47
SS6	Day	42-51	54	52	51	55	51	51	57
	Night	34-47	44	45	45	45	45	45	47
Note: Shaded cells indicate that the modeled sound level exceeds King County's allowable limit.									

With a 2 meter/second wind blowing from the main noise sources to each receptor, ENM predictions indicate that project-related noise would meet King County's daytime and nighttime standards except, perhaps, at residences represented by receptor location GB7. Receptor GB7 is located in a residential area on a hill overlooking the Gold Beach community. By phases 5 & 6, much of the intervening topography on the Maury Island site will have been excavated. Even so, the 1-dBA exceedance is too close to call a violation given the conservative nature of these calculations. Model predictions at GB7 indicate, however, that noise from nighttime barge-loading operations would exceed the 47 dBA limit at night (10 p.m. to 7 a.m. weekdays, 10 p.m. to 9 a.m. weekends and holidays) with a wind blowing from the southwest to the northeast.

Off-site Truck Noise

The proposed action is to barge most of the product from the site. Exporting the remaining product by truck would not generate a significant amount of truck traffic. Therefore, this noise analysis does not estimate future truck noise.

MITIGATION MEASURES

Construction

The construction of perimeter berms, the refurbishing and/or construction of on-site equipment, and the preparation and reclamation of mining areas would take place during daytime hours to minimize noise impacts to neighboring residents.

Operation

Mitigation measures included in this analysis include:

- Construction of a 12-foot berm on the western perimeter and in the northeastern corner of the Maury Island site to ensure that there is always a sufficient barrier between the excavating bulldozers (or front-end loaders) and nearby residences.
- Regular maintenance of the conveyor system and the barge loading conveyor to ensure that squeaking of the equipment is eliminated or minimized.
- Use of strobe lights instead of audible alarms for all audible warning devices used on-site during nighttime operations.

Incorporation of these mitigation measures into the construction and operation of the Maury Island pit would likely ensure compliance with the King County Noise Code and would often result in sound levels much lower than allowed by the code.

ATTACHMENT A

Summary of Sound Level Measurement taken at 25914 Gold Beach Drive

Date	Time	Leq	Lmax	Lmin	L(2)	L(8)	L(25)	L(90)
Feb 16, 1998	17:00:00	51	72.9	42.5	57.4	53	50.9	46.7
Feb 16, 1998	18:00:00	45.6	58.3	37.8	51.1	48.7	46.3	41.1
Feb 16, 1998	19:00:00	44.7	67.6	33	51.5	47.8	44.5	37.1
Feb 16, 1998	20:00:00	46.2	61.3	34.8	54.8	49.7	45.9	38.1
Feb 16, 1998	21:00:00	42.8	59	33	51	46.6	42.6	34.8
Feb 16, 1998	22:00:00	43.6	67.1	32.7	51.4	45.9	40.7	34.2
Feb 16, 1998	23:00:00	39.4	57.4	32.9	45.9	42.8	39.8	34.3
Feb 17, 1998	00:00:00	37.9	57.9	31.4	45.9	40.1	35.8	32.8
Feb 17, 1998	01:00:00	40.1	56.2	31.4	49.6	44.3	38.1	32.5
Feb 17, 1998	02:00:00	41.2	60.5	31.1	49.5	44.1	41.2	32.3
Feb 17, 1998	03:00:00	45.2	65.5	35.8	48.8	46.8	45.5	41.5
Feb 17, 1998	04:00:00	40.9	61.3	33.1	49.8	43.2	39.2	35.3
Feb 17, 1998	05:00:00	41.5	57.9	35	46.9	44	42.3	37.8
Feb 17, 1998	06:00:00	44.9	61.8	37	52.6	48.7	44.4	39.3
Feb 17, 1998	07:00:00	45.6	60.6	38	52.5	49.3	45.9	40.4
Feb 17, 1998	08:00:00	46.8	66	38.8	54.6	50.1	45.9	41
Feb 17, 1998	09:00:00	50.2	76.6	38.8	57.2	49.8	45.9	40.7
Feb 17, 1998	10:00:00	48	72.9	38.1	55.7	51.5	47.1	40.5
Feb 17, 1998	11:00:00	48.4	79.5	35.5	56.6	50.2	45.9	38.8

Summary of Sound Level Measurement taken at 8909 SW 274th Street

Date	Time	Leq	Lmax	Lmin	L(2)	L(8)	L(25)	L(90)
Feb 16, 1998	16:00:00	48.5	80.4	39.5	53.1	50.1	48.2	43
Feb 16, 1998	17:00:00	45.8	65.7	37	51.8	48.7	46.7	40.2
Feb 16, 1998	18:00:00	44.7	63.2	32.9	52.1	48.4	45.7	36.3
Feb 16, 1998	19:00:00	44.2	64.6	30.8	52.7	48.7	44.2	34.2
Feb 16, 1998	20:00:00	42.5	60.2	32.6	50.7	46.9	41.8	34.8
Feb 16, 1998	21:00:00	43.9	66.1	32.1	52.6	47.6	42.5	33.9
Feb 16, 1998	22:00:00	43.2	62.1	31.3	52.4	47.8	40.8	34.3
Feb 16, 1998	23:00:00	39.6	59.1	31.9	48.3	42.5	38.1	33.2
Feb 17, 1998	00:00:00	36.8	58.3	30.5	45.5	38.8	34.3	31.8
Feb 17, 1998	01:00:00	37	62.6	30.2	43.5	38.9	34.4	31.6
Feb 17, 1998	02:00:00	40.4	64.6	29.9	48.8	40.7	36.1	31.7
Feb 17, 1998	03:00:00	37.1	57.9	30.4	42.7	38.6	36.6	33.1
Feb 17, 1998	04:00:00	41.1	64.2	30.9	49.9	41.9	39.4	33.2
Feb 17, 1998	05:00:00	41.6	58.1	36.6	47.5	43.6	41.7	38.6
Feb 17, 1998	06:00:00	46.4	61.7	37.6	52.4	48.9	47	40.6
Feb 17, 1998	07:00:00	48.2	60.9	44.8	53.7	50.4	48	45.9
Feb 17, 1998	08:00:00	50.9	72.6	44.4	57.2	51.9	48.2	45.8
Feb 17, 1998	09:00:00	49.5	70.3	37.9	57.5	50.8	47.6	40.3
Feb 17, 1998	10:00:00	48.2	66.3	37.7	54.7	51.3	48.3	41

REFERENCES

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